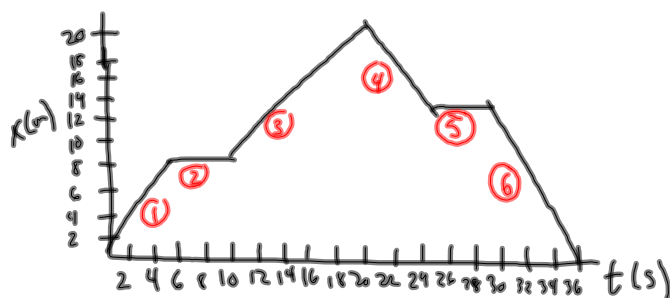


Velocity and Speed:

- Speed:
 - scalar
 - magnitude of velocity
 - definition: $\frac{\text{distance}}{\text{time}}$
- Velocity:
 - Vector
 - definition: $\frac{\text{displacement}}{\text{time}}$
- Use same letter for both:
 - $\vec{v} \rightarrow \text{velocity}$
 - $v \rightarrow \text{speed}$
 - $\text{speed} = |\text{velocity}|$
 - $v = |\vec{v}|$
- Base units are same for both:
 - $\frac{\text{meters}}{\text{seconds}} \text{ (m/s)}$
- In a displacement v. time graph, the slope of the function is the object's velocity.

Velocity and Acceleration Notes 1.26.12 Honors Physics



Find the velocity and speed for each section.

$$\bar{V}_1 = \frac{\bar{x}_f - \bar{x}_i}{t_f - t_i} = \frac{8\text{ m} - 0\text{ m}}{6\text{ s} - 0\text{ s}} = +1.33\text{ m/s}$$

f → final
i → initial

$$V_1 = 1.33\text{ m/s}$$

$$\bar{V}_2 = \frac{8\text{ m} - 8\text{ m}}{10\text{ s} - 6\text{ s}} = 0\text{ m/s} \quad V_2 = 0\text{ m/s}$$

$$\bar{V}_3 = \frac{20\text{ m} - 8\text{ m}}{20\text{ s} - 10\text{ s}} = 1.2\text{ m/s} \quad V_3 = 1.2\text{ m/s}$$

$$\bar{V}_4 = \frac{14\text{ m} - 20\text{ m}}{24\text{ s} - 20\text{ s}} = -1.5\text{ m/s} \quad V_4 = 1.5\text{ m/s}$$

$$\bar{V}_5 = \frac{14\text{ m} - 14\text{ m}}{28\text{ s} - 24\text{ s}} = 0\text{ m/s} \quad V_5 = 0\text{ m/s}$$

$$\bar{V}_6 = \frac{0\text{ m} - 14\text{ m}}{36\text{ s} - 28\text{ s}} = -1.75\text{ m/s} \quad V_6 = 1.75\text{ m/s}$$

• average velocity:

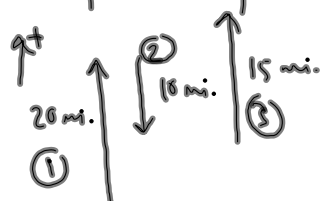
$$\begin{aligned} \bar{V}_{\text{avg.}} &= \frac{\text{total displacement}}{\text{total time}} \\ &= \frac{0\text{ m} - 0\text{ m}}{36\text{ s} - 0\text{ s}} = 0\text{ m/s} \end{aligned}$$

• average speed:

$$\begin{aligned} V_{\text{avg.}} &= \frac{\text{total distance}}{\text{total time}} \\ &= \frac{8\text{ m} + 0\text{ m} + 12\text{ m} + 6\text{ m} + 0\text{ m} + 14\text{ m}}{36\text{ s}} \\ &= 0.96\text{ m/s} \end{aligned}$$

A school bus travels 20 miles north in 30 minutes, 10 miles south in 15 minutes, then 15 miles north in 10 minutes. Find the velocity and speed of each section and the average velocity and speed.

Graph on displacement v. time graph.



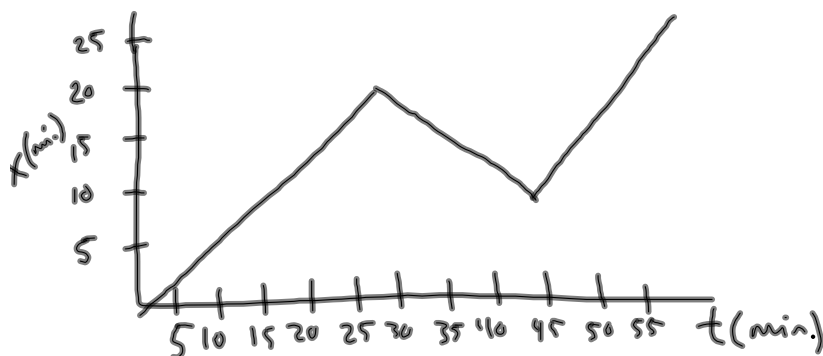
$$\bar{V}_1 = \frac{20 \text{ mi}}{30 \text{ min}} = 0.67 \text{ mi./min.}$$

$$\bar{V}_2 = \frac{-10 \text{ mi.}}{15 \text{ min.}} = -0.67 \text{ mi./min.}$$

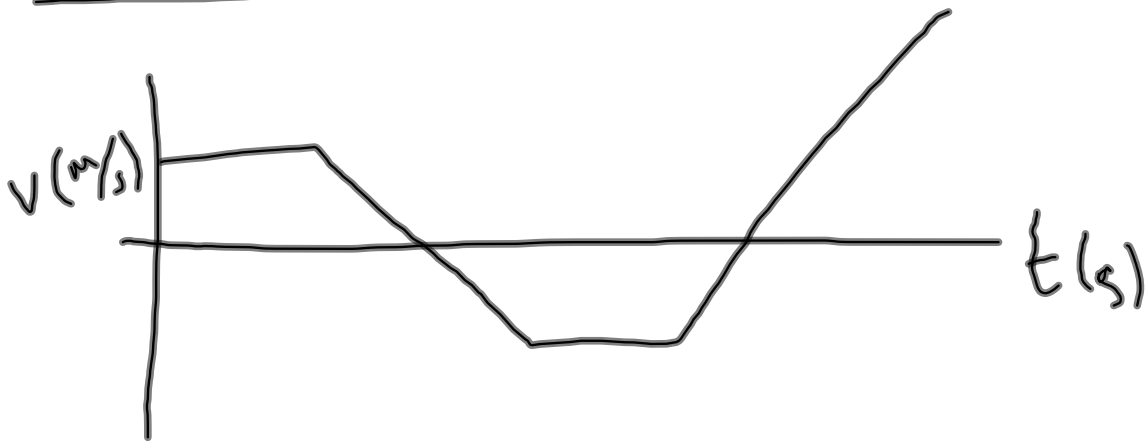
$$\bar{V}_3 = \frac{15 \text{ mi.}}{10 \text{ min.}} = 1.5 \text{ mi./min.}$$

$$\bar{V}_{\text{avg.}} = \frac{25 \text{ mi.}}{55 \text{ min}} = 0.45 \text{ mi./min.}$$

$$V_{\text{avg.}} = \frac{20 \text{ mi.} + 10 \text{ mi.} + 15 \text{ mi.}}{55 \text{ min.}} = 0.82 \text{ mi./min.}$$



Velocity v. time graphs:



- Slope is acceleration
- Zero slope \rightarrow constant velocity or not moving
there is no acceleration
- Positive line \rightarrow object's velocity is increasing
- Negative line \rightarrow object's velocity is decreasing
(decelerating)